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ANALYSIS OF OFFICER PERFORMANCE ON AN EXPERIMENTAL TASK--COMMUNICATIONS EXHIBIT

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ANALYSIS OF OFFICER PERFORMANCE ON AN EXPERIMENTAL TASK--COMMUNICATIONS EXHIBIT

BACKGROUND

The Communications Exhibit Task is one of 15 situational performance exercises developed and administered as a segment of a large-scale longitudinal research project initiated in response to recommendations by the Army Scientific Advisory Panel (ASAP) and the Deputy Chief of Staff for Personnel (DCSPER). The former indicated a need for additional research on the performance and selection of combat officers and suggested that dimensions of such performance might be defined by means of performance exercises within a combat simulation. DCSPER, in view of the increasing complexity of military technology, was interested in determining the feasibility of differential prediction of performance for broad areas of possible officer specialization. The research design incorporates both sets of requirements. The differential prediction aspect of the research is concerned with three broad areas--combat, administrative, and technical. Experimental predictor tests relevant to these areas were administered to 6900 officers on entrance to active duty in 1958 and 1959, and a revised battery to 4000 on entrance to active duty from 1961 to 1964. Fifteen to thirty months later, a subsample of 900 of the latter group, six at a time, were assigned to the Officer Evaluation Center, Fort McClellan, Alabama, established for the purpose of providing criterion data on officer performance. There, in a simulated Military Assistance Advisory Group (MAAG) setting, over a period of three days, a scenario unfolded which eventuated in invasion and guerrilla warfare. Each group of six officers received a series of assignments, first administrative and technical, and then combat. Performance was recorded and rated out of sight of the examinee by cadre who played the parts of MAAG, host nation, and aggressor personnel. Work products were retained for later scoring. The performance records and work products, after analysis to define underlying dimensions, serve as criteria for the predictor tests.

The Communications Exhibit Task was one of the five in the technical area and was performed on the first day. It was designed to measure trouble-shooting ability and ability to use effectively technical facilities and manuals and the services of an enlisted assistant. The examinee's job was to diagnose and, if possible, to get into working order an assemblage of telephone equipment which was to be used shortly to demonstrate to host nation officers the operation of a field network. The examinee had two hours to complete the task. He was given a circuit diagram and requisite manuals and an inexperienced enlisted man was assigned as his assistant. Some spare equipment was on hand. When the examinee discovered but could not correct a defect, he was to record the symptom and the location of the trouble and recommend corrective action.

The equipment and interconnections contained fifteen defects or "bugs," including missing, defective, or wrongly inserted parts, missing or inaccurate line tags, and short, open, or misconnected circuits. Repairs made

by the examinee and the examinee's notes provided the basis for the entries on the main scoring record, the Trouble Scoring Sheet. At the end of the two hours, the officer in charge, ostensibly to prepare himself to assist the signal officer in demonstrating the equipment, questioned the examinee concerning operation of the equipment. The subject officer's responses were scored unobserved by the enlisted man on a Question Scoring Sheet. Various aspects of the examinee's performance and various personal characteristics were rated at the end of the task by the enlisted man and by the officer in charge, the latter basing his judgment in part on observations through a one-way screen.

OBJECTIVES

The main objectives of the present analysis were to obtain dimensions (factors) summarizing the performance and behavior represented in the scoring records on the Communications Exhibit Task and to provide scores for major parts of the scoring record, the dimensions, and the task as a whole. These scores will be correlated with scores from the other 14 tasks to indicate the extent to which each score is specific to the task, common to the tasks of the technical area, and general across all three areas. From these scores and those of the other tasks, criterion scores will then be derived to validate the experimental predictor tests.

METHOD

SAMPLE

The sample consisted of 846 officers for whom Communications Exhibit scoring records were available. For ratings of motivation and attitude, which were introduced after the test had been administered to several groups, only 726 cases were available, and for ratings introduced still later, on factors that the rater would consider if he were making an overall evaluation, 694 cases.

VARIABLES

Principal variables are listed in Table 1. These variables, except total score (to be described later), were derived from four scoring forms.

1. Trouble Scoring Sheet. For each of the 15 "bugs" in the apparatus, labeling, or circuits, a checkmark indicated which, if any, of the acceptable corrective actions was taken by the examinee; if he did not correct the defect, checkmarks indicated whether he had recorded the symptoms, indicated the location of the trouble, and recommended appropriate corrective action. Scores of three types were obtained: for each

corrective-action-taken alternative, a 1, 0 score; for each "bug", a score from 0 to 4, 1 for recording the symptom only, 2 for recording location, 3 for recommending appropriate corrective action, and 4 for taking corrective action; and a total score.

2. Questions Scoring Sheet. Checkmarks indicated which of various creditable answers were given to the questions of the officer in charge. Three scores were obtained: 1) 1, 0 score for each answer, 2) score for each question (answer credits were summed when the question required more than one creditable answer), and 3) total score. In computing questions and total scores, double weight was given to certain answers judged especially important or superior to alternative answers which merited credit.

3. Problem Approach Checklist. Three variables were rated by both the enlisted man and officer in charge: problem approach (the extent to which the examinee was systematic in undertaking his task), effective use of the enlisted man, and extent of use of the manuals (appropriate, too great, or too little). An option in rating on use of the manuals provided for identification of examinees who were judged sufficiently familiar with the equipment that they did not need to use the manuals. Because of close agreement, only ratings by the officer in charge were scored except when the form was incomplete. (Each rating option was scored zero-one, and each of the three main variables zero-one or zero-one-two.)

4. Descriptive Report II. This report form, completed by both the officer in charge and the enlisted man, required the rating of motivation and attitude, each on a five-point scale and scored 1 to 5, and indication of which of ten listed factors seemed particularly pertinent to evaluation of the subject officer's overall performance. Seven of the factors are listed in Tables 1 and 2; the other three are Effective Expression, Endurance and Stamina, and Other (to be specified by the rater). Also indicated was whether the officer was considered strong or weak on a selected factor. Each of the listed factors was scored 0 if designated as a weak point, 2 if designated as a strong point, and 1 if neither. Three sets of Descriptive Report scores were obtained, one for the officer in charge, one for the enlisted assistant, and for the two summed.

ANALYSIS

Scores at the sub-item level (specific corrective actions for each "bug," specific answers to questions, and specific rating steps on the Problem Approach Checklist) were intercorrelated (product-moment r's) together with Trouble Scoring total, Question Scoring total, and Descriptive Report factor total. The objectives were to evaluate sub-item validity by means of correlation with totals, to identify among sub-items having low correlation with totals any clusters suggestive of atypical but valid content, and to evaluate the desirability of and appropriate ratios for weighting of sub-items.

After changes indicated by the analysis, scores at the item level (specific "bugs", specific questions, and specific rating scales, including only those of the 10 rated factors that were indicated as important on at least 5% of the forms) were intercorrelated, together with Trouble Scoring total, Question Scoring total, and Descriptive Report factor total. Objectives were to evaluate item scores in the same manner as scores at the sub-item level and to provide a basis for factor analysis. The judgment as to whether the examinee was sufficiently familiar with the equipment that he did not need to use the manuals, from Descriptive Report II, scored 0, 1, was included.

The factor analysis was by the principal-component method. Results were rotated by the varimax procedure. Scores for factors were established by selection of high loading variables with relatively low loadings on other factors.

Reliability of major components was estimated from element and composite variances by means of Cronbach's alpha. Reliability of motivation and attitude ratings was evaluated by correlation between ratings provided by the officer in charge and those provided by the enlisted assistant.

For use in cross-test and other analyses, a total-score formula was established, consistent with the following considerations:

1. Measures of performance would be preferred to measures of personal attributes.

2. Measures of accomplishment would be preferred to scores representing procedures or means.

3. Objective scores, if sufficiently comprehensive, would be preferred to subjective.

4. In the absence of an independent, more nearly ultimate criterion, differential weighting would not be undertaken for fairly homogeneous items nor to replace natural weights of internally homogeneous item groups whose respective size appeared reasonably proportional in importance to the performance represented.

5. The composite should cover all major parts of the task.

6. High reliability (if not achieved through undue reduction in comprehensiveness) was desirable.

RESULTS

ITEM SCORES AND INTERCORRELATIONS

On the basis of sub-item intercorrelations, a few changes were made in the initially established item scores--elimination of credit for

certain corrective actions having lower correlation with composites and appearing less desirable on rational grounds, and minor alteration of weights for Trouble Shooting Approach and Use of Manuals alternatives.

Three rated factors were eliminated from further analysis largely because of infrequent indication of importance and low variance, but also because there was only minimal requirement in this task for the first two of the traits represented. These three rated factors are Effective Expression, Endurance and Stamina, and Other Factors (to be specified by the rater). No other variables had variance so small or p-values so extreme that elimination seemed appropriate. Intercorrelations of remaining items and of totals are shown in Table 1.

RELIABILITY

The Cronbach alpha reliability coefficient for the Trouble Scoring Sheet total was .84 and for the Question Scoring Sheet total .63.

Correlation coefficients obtained between ratings given by the officer in charge and by the enlisted assistant on motivation and attitude were .75 and .70, respectively. Coefficients were not obtained for Problem Approach Checklist variables nor for the Descriptive Report factors considered.

FACTOR ANALYSIS

The varimax rotation at the 9-factor level was accepted. Fifty-four percent of the total variance was accounted for (1.2% more than by the 8-factor solution), and three to eleven percent by each of the rotated factors. The nine factors are identified below. For each factor, the higher-loading variables which contribute to its definition and serve also as a factor score are designated by item number, if any, and listed in order of the magnitude of the loading, which is given in parentheses.

1. Equipment "bugs."

    2. Battery missing from a phone (.68).

    4. A circuit selector switch in wrong position (.65).

    1. A missing transmitter unit (.63).

    13. A defective transmitter unit (.34).

2. Motivation and attitude. (Preference was given to the composite ratings of officer and EM, though loadings were slightly lower than for officer alone.)

Table 1

CORRELATIONS AMONG SCORES

Variable	Intercorrelations[a]														
1. Total Problem Score	1														
2. Total Question Score	61	2													
3. Total Score[c]	99[b]	81[b]	3[c]												
4. Troubleshooting Approach	61	48	76	4											
5. Utilization of Personnel	35	22	57	32	5										
6. Use of Manuals	58	45	80	55	29	6									
7. Motivation	63	48	69	56	45	55	7								
8. Attitude	53	44	58	50	44	51	88	8							
9. Bearing and Assurance	53	42	73	43	35	46	54	52	9						
10. Keeping Cool	20	23	36	28	16	25	33	33	29	10					
11. Familiarity with Equipment	60	48	78	56	32	59	46	42	37	13	11				
12. Following Instructions	58	44	80	46	39	47	56	48	39	17	40	12			
13. Extent of Mission Accomplishment	83	53	95	62	50	63	58	49	48	22	62	57	13		
14. Effective Command and Control	20	14	20	21	37	22	20	23	18	12	13	18	21	14	
15. General Impression	18	19	35	15	15	20	24	64	27	15	12	14	17	07	15
16. Total of Factors Considered (9-15)	81	61	92	68	53	70	71	82	67[b]	36[b]	75[b]	75[b]	87[b]	32[b]	31[b]

[a]Decimal points omitted.

[b]The coefficient represents a part-whole relationship.

[c]Tetrachoric correlation coefficients (the others are product-moment).

Attitude composite (.82).

Motivation composite (.78).

3. Questions on equipment functions.

2. Functions of a terminal box (.61).

3. Reasons for tagging lines (.55).

6. Advantages of using 5-pair rubber cable (.44).

4. Circuit "bugs."

8. A misconnection at a terminal (.67).

14. An open trunk (.65).

9. A shorted line (.63).

15. Line attached to wrong binding posts (.55).

5. Familiarity with equipment.

Factor considered--familiarity with equipment (.73).

Knew equipment so did not need manuals (.70).

6. Tagging "bugs."

7. A missing tag (.62).

6. A mistagged line (.60).

7. Utilization of enlisted man.

Utilization of personnel (.56).

Factor considered--effective command and control (.48).

8. Questions on circuits.

1. Whether any phone in the net can call any other (.58).

4. Alternate route for a specified call (.47).

7. Circuit modification required for a specified call (.46).

9. Bearing.

Factor considered--bearing and assurance (.51).

Factor considered--keeping cool (.43).

Factor considered--general impression (.36).

The Appendix presents, for items and their sums, all loadings of .20 or higher on the 9 factors. Communalities ranged from .14 (Bug #3, a defective signal lamp) to .99 (Trouble Scoring Sheet total).

TOTAL SCORE

The total established for use as a comprehensive score in examining relationships of the test with outside variables consisted of the standard score on the Question Scoring Sheet total plus three times the standard score on the Trouble Scoring Sheet total. This sum was converted to a score with a mean of 500 and standard deviation of 100. The estimated reliability of the composite was .86 vs .63 and .84 for the two component scores, respectively.

REFERENCES

Administering and scoring the Differential Officer Performance Communications Exhibit Test. BESRL Publication.--Undated.

Willemin, L. P. Prediction of officer performance. BESRL Technical Research Report 1134. March 1964.

APPENDIX

FACTOR LOADINGS
(Of .20 and greater)

Variables	Factors								
	1	2	3	4	5	6	7	8	9
Trouble Scoring Sheet. Bugs:									
1	.63						.25		
2	.68								
3					.27				
4	.65								
5	.34								
6						.60			
7						.62			
8				.67					
9				.63	.33				
10	.41			.30					
11	.33	.20		.59					
12	.35			.48				.24	
13	.52			.30				.24	
14				.65	.20				
15	.26			.55				.21	
Total	.60	.21		.61	.23	.28			
Question Scoring Sheet. Questions:									
1								.58	
2			.61						
3		.23	.55						
4			.30	.22				.47	.26

APPENDIX (Continued)

FACTOR LOADINGS
(Of .20 and greater)

Variables	Factors								
	1	2	3	4	5	6	7	8	9
5	.25		.29		.20				
6			.44			.23	.27		
7		.20	.23	.22				.46	
Total	.22		.61	.26				.55	
Problem Approach Checklist									
Troubleshooting Approach	.39	.25	.22	.22	.36				.30
Utilization of Personnel		.27					.56		
Use of Available Manuals	.32	.25		.25	.42				.31
Knew equipment (did not need manuals)					.70				
Motivation									
Officer in charge	.22	.81		.25					
Officer and EM	.25	.78		.28					.21
Attitude									
Officer in charge		.86							
Officer and EM		.82					.20		.22
Factors Considered									
Bearing and assurance	.22	.31		.30					.51
Keeping cool						.22			.43
Familiarity with equipment	.23			.29	.73				
Following instructions	.24	.27		.37			.39		
Mission accomplishment	.46			.53	.34				
Effective command and Control							.48		
General impression									.36
Total	.36	.28	.20	.45	.42		.39		.39